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(19)

(54) METHOD OF KNOCKING OUT SILICATE-BONDED GRANULAR MOULD MATERIAL FROM A MOULD AFTER CASTING

We, KOHLSWA JERNVERKS AKTIEBOLAG, a Swedish Company of Kolsva, Sweden, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it it is be performed, to be particularly described in and by the following Statement:–

In the production of moulds and cores for casting metallic materials, for example cast iron, cast steel, light metals and bronzes, there is often used a granular mould material containing sand and a silicate-binder, usually water glass (sodium silicate). The silicate can be hardened, among other things, with the held of an organic ester, for example triacetin, which is mixed into the mould material, or with carbon dioxide which is led through the prepared cores or moulds. The hardening takes place due to precipitation of silica gel which bonds the sand grains, and is usually performed at room temperature. When using ester hardening, the sand and ester are normally mixed first, whereafter the silicate is supplied to the mixture of sand and ester. Immediately after the silicate has been mixed in, the mould is prepared. The pattern can usually be drawn after 15 to 30 minutes whereas casting the metallic material is possible only after a couple of hours.

A generally recognised problem with silicate-bonded granular mould materials is their poor break-down properties, which necessitates a difficult mechanical knock-out of the hardened mould material, for example with a vibrator and a sledge, to expose the cast body. The knock-out operation is a hard manual operation in a dusty and noisy environment. The mould residue, consisting of silicate-bonded lumps of sand in varying sizes and reinforcing iron bars, is carried away to be dumped on a waste disposal tip, or alternatively to be subjected to regeneration in a special plant.

It is known that the break-down properties of silicate-bonded granular mould materials can be improved by adding to the mould material different organic substances, for example sugar, dextrin, starch, wood meal and pulverised coal. The improvement of the break-down properties that can be achieved by adding said substances, however, far from solves the knock-out problems. Also when using the additives it is still necessary to employ mechanical methods for the knock-out.

The present invention aims to provide a method of knocking out silicate-bonded granular mould material from a mould after casting, which avoids difficult mechanical methods and the drawbacks connected therewith.

According to the invention a method of knocking out silicate-bonded granular mould material from a mould after casting, i.e. from a mould containing a casting and possibly a core, is characterised in that the bonded material in the mould after casting is contacted with an alkaline aqueous solution to loosen the bond between the grains by dissolving the silicate binder.

Knock-out of the mould material and the exposure of the casting are radically facilitated by the method according to the invention. In addition, the method has the advantage of making possible, with simple methods, regeneration of the used granular mould material so that this can be re-used for manufacture of moulds and cores.

The bonded material in the mould after casting can be subjected to the effect of the alkaline aqueous solution in various ways, for example, by being immersed in a bath of the solution or by having the solution poured, sprinkled or sprayed over it. Pouring, sprinkling and spraying in many cases involve advantages over immersion, because with such methods it is possible to achieve a successive removal of mould material broken down from the surface of the mould so that the underlying mould material is more effectively accessible to the alkaline aqueous solution. Spraying is particularly valuable in the case of knock-out of cores, since removal of mould material is normally more troublesome with cores. A suitable pressure on the aqueous solution in the case of spraying may be from 1 to 50 atmospheres. If, however, it is desirable at

the same time to expose a clean metallic surface of the casting, in the mould, it may be necessary to use a higher pressure, for example from 50 to 300 atmospheres. For economical reasons, the aqueous solution, after it has been used for pouring, sprinkling or spraying of the mould after casting and after it has been separated from the released mould material, should be recirculated to the knock-out equipment to be used for pouring, sprinkling or spraying of new cast moulds.

The method according to the invention may be used for knocking out any known silicate-bonded granular mould material, for example mould material manufactured from quartz sand, chromite sand, olivine sand or other sand used in the casting technique, and which is bonded with water glass or other water-soluble silicate. A conventional way of preparing such mould material involves adding an amount of silicate which is suitably from 0.5 to 5 per cent of the weight of the sand. The silicate is normally added in the form of an aqueous solution, and in the amount of silicate mentioned above the water is not included. Hardening of the mould material may be performed in any conventional manner. Thus, although hardening with carbon dioxide and with organic ester are of particular importance, hardening with other substances mixed into the mould material, for example acids, may also be used. Esters which are often used as hardeners are mixtures of diacetin (glyceryl diacetate) and triacetin (glyceryl triacetate) or mixtures of diacetin and ethyl diglycol diacetate in various weight ratios depending on the desired hardening times. The esters mentioned may also be used separately. Among other esters which may be used are acetates of glycol. The amount of ester added to the sand when preparing the mould material suitably is from 0.05 to 2 per cent of the weight of the sand. When manufacturing the ester-hardening mould material, the mixture of the components may be carried out, for example in a continuous screw mixer, the sand and ester normally being mixed before the silicate is added, as mentioned earlier. The mould may be manufactured by allowing the mould material, after the mixing in of the silicate, to run down over the pattern which is suitably vibrated or rammed. When the mould has been allowed to harden for a period of from 15 to 30 minutes, the pattern can be drawn. The top and bottom parts of the mould are then put together after a few additional hours of hardening. Casting which is usually performed after a further period of at least six hours, amy be carried out, for example, from a bottom-discharging ladle. Any cores used can be manufactured in a corresponding manner, if desired. When the casting has cooled, the cast mould is treated with the alkaline aqueous solution in accordance with the method of the present invention.

The alkaline aqueous solution can be produced by dissolving sodium hydroxide, potassium hydroxide and/or other alkali metal hydroxide(s) and/or ammonia in water. Substances other than these, which give aqueous solutions sufficient alkalinity, may, of course, be used as well. The pH value of the aqueous solution suitably amounts to at least 12, and preferably to at least 13. When using alkali metal hydroxide to achieve the alkalinity, the amount of alkali metal hydroxide should be at least 0.4 per cent, suitably from 0.4 to 20 per cent and preferably from 0.4 to 10 per cent the total weight of hydroxide and water. When using ammonia, the preferred amount is from 10 to 30 per cent of the total weight of ammonia and water.

An increase of the temperature of the aqueous alkaline solution markedly improves the break down of the mould material. In particular, if there are problems in breaking down the mould material located adjacent to the casting which has therefore been exposed to the most heat, it may be necessary to raise the temperature of the aqueous alkaline solution (eg by applying it while the mould material is still hot from the casting). If such problems exist, the use of a high content of alkali metal hydroxide in the aqueous solution is also recommended. The temperature of the aqueous solution is suitably at least 40°C and suitably at the most 100°C, preferably from 50°C to 80°C. The treatment is normally carried out at atmospheric pressure for a time of from one minute to one hour.

When the castings have been exposed from the mould material they are cleaned by washing or rinsing with water.

The broken down mould material in the form of sand contaminated with alkali metal hydroxide can be used after cleaning (for example repeated rinsing with water and subsequent drying) for the manufacture of new mould cavities. When using ester hardeners, ester is first mixed into the cleaned mould material, as described earlier, and then water glass or other silicate binder. The mould material is thereafter ready for the manufacture of new moulds.

The invention will now be illustrated by the following non-limitative Examples, in which parts and percentages are by weight.

EXAMPLE 1

A mould material is manufactured from quartz sand with a medium grain size of 0.25 mm. The sand is first mixed with 0.4 per cent (calculated on the weight of the sand) of an ester hardener consisting of a mixture of equal parts of diacetin and triacetin and thereafter with 4 per cent (calculated on the weight of the sand) of water glass containing 40 per cent of silicate and 60 per cent of water. After manufacture of a block mould and the pouring of a steel casting in conventional manner, the cast mould is allowed to cool until the casting has a temperature of between 200°C and 500°C. While still hot it is immersed in a bath at a temperature of from 55° to 60°C consisting of a 3 per cent

sodium hydroxide solution. After about five minutes the mould material has been broken down and the casting exposed.

EXAMPLE 2

A cast mould is manufactured in the manner described in Example 1. A 3 per cent sodium hydroxide solution at a temperature of from 55° to 60°C is then poured over it. After a few minutes the mould material has been broken down and the casting exposed.

EXAMPLE 3

A flask mould is manufactured of the same mould material as described in Example 1. After casting the mould is immersed in an alkaline bath of the same kind as described in Example 1. In this case also the mould material is broken down and the casting is exposed rapidly. Because the cast mould is located in a flask, however, the breakdown and the exposure will require a somewhat longer time than for a block mould.

EXAMPLE 4

A flask mould is manufactured in the manner described in Example 3. After casting, the mould is sprayed with an alkaline aqueous solution of the same kind as in Example 1 at a pressure of about 5 atmospheres. In this case also the mould material is broken down and the casting exposed rapidly.

EXAMPLE 5

Mould material which has been broken down according to any of Examples 1 to 4 is filled into a container which is filled with water and which is continuously supplied with water by means of a sprinkling device at the bottom of the container. The last-mentioned supply of water creates turbulence in the water and a continuous through-flow of water. The water leaves the container through a spillway. The mould material is washed during its passage through the water, the fine part of the mould material leaving the container through the spillway. The treatment is carried out so that the pH value in the water is maintained below 10. When the washing is finished the sand is removed from the container and dried in a sand drying plant. The sand thus regenerated for re-use is mixed first with 0.4 per cent (calculated on the weight of the sand) of ester hardener consisting of equal parts of diacetin and triacetin and thereafter with 4 per cent (calculated on the weight of the sand) of water glass containing 40 per cent of silicate and 60 per cent of water. The mould material is applied to a pattern and is allowed to harden for 20 minutes, whereafter the pattern is drawn. After a hardening time of 8 hours, casting takes place and after knock-out the casting exhibits good surfaces and there is no tendency for metal to penetrate the mould material.

The method according to the invention is applicable to the knocking out and regenerating of silicate-bonded granular mould materials from all kinds of casting operations, for example the casting or iron steel, light metals and bronzes.

WHAT WE CLAIM IS:—

1. A method of knocking out silicate-bonded granular mould material from a mould after casting, in which the bonded mould material, after casting, is contacted with an alkaline aqueous solution to loosen the bond between the grains by dissolving the silicate binder.
2. The method claimed in claim 1, in which after casting the mould is immersed in the alkaline aqueous solution.
3. The method claimed in claim 1, in which the alkaline aqueous solution is poured, sprayed or sprinkled over the mould after casting.
4. The method claimed in any of the preceding claims, in which the aqueous solution has a pH value of at least 12.
5. The method claimed in any of the preceding claims, in which the aqueous solution has been made alkaline with an alkali metal hydroxide.
6. The method claimed in any of claims 1 to 4, in which the aqueous solution has been made alkaline with ammonia.
7. The method claimed in any of claims 1 to 5, in which the aqueous solution contains at least 0.4 per cent by weight of an alkali metal hydroxide.
8. The method claimed in any of the preceding claims, in which the temperature of the aqueous solution is at least 40°C.
9. The method claimed in any of the preceding claims, in which the alkaline aqueous solution is removed from the granular mould material recovered from a knocked-out mould to make it re-usable for the manufacture of new moulds and/or cores.
10. The method claimed in claim 9, in which the knocked-out granular mould material is washed with water until the pH value of the washing water has dropped to 10 at the most.
11. The method claimed in any preceding claim, in which the contact with the alkaline aqueous solution is carried out while the granular material is still hot from the casting.
12. A method of knocking out silicate-bonded mould material from a mould substantially as described in any of the foregoing Examples 1 to 4.

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